GASTROINTESTINAL INTUBATION OF THE INTACT UNANESTHETIZED DOG[1]

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Intubation of the dog, for both motor and biochemical studies, has long been a fundamental part of classic physiology because of the availability of the dog and the general resemblance of its function to that of the human.

Fistulae and pouches of many kinds have been devised for all levels of the gastrointestinal tract; these, however, require some surgical facility and aftercare. Moreover, they are open to the objection of an altered physiology as well as

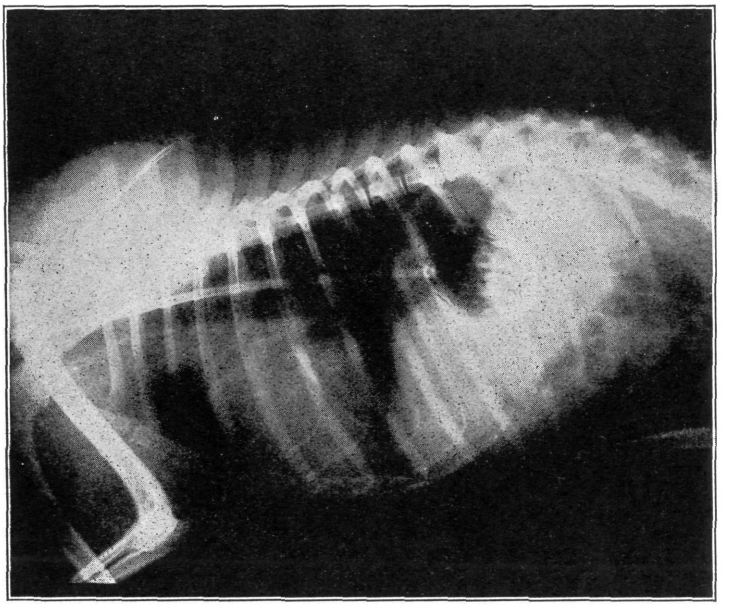

Fig. 1. Barium coated balloon on Rehfuss tube, in stomach of dog.

anatomy, which can often be disproved for a given purpose only by comparison with intubation of the intact animal. This usually requires training, which is troublesome and occasionally open to objection because of conditioned reflexes created, or it involves restraints to prevent the animal from displacing or even biting through and swallowing the tube. If the animal is made markedly uncomfortable, there are derangements throughout the organism as demonstrated for the stomach as early as 1916. (1) This is unfortunate particularly because of the promising possibilities in quantitative studies over periods of several hours.

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New fields have been opened by the development of the Miller-Abbott tube in its various forms. (2) These utilize the principle of propulsion of a multiple lumen tube by peristalsis acting on a balloon inflated after it has passed the pyloric sphincter. This leaves the other lumina free for aspiration or for registration of contractions with similar balloons. Barium may be injected through the tube to outline the gut, and the tube itself is sufficiently opaque to permit X-ray observation of its course. Figure 1 is a plate of the tube used for routine gastric motility work—a Rehfuss gastro-duodenal tube with the bucket replaced by a balloon (distal third of standard condom). A centimeter length of small glass tubing is slipped into the tip of the tube to prevent occlusion of its lumen by the silk thread used to tie the balloon. A pinch of barium sulfate mixed with a lubricating jelly free from grease (e. g., a tragacanth base) is placed in the balloon where it distributes itself and remains indefinitely without clogging. Such a tube does not

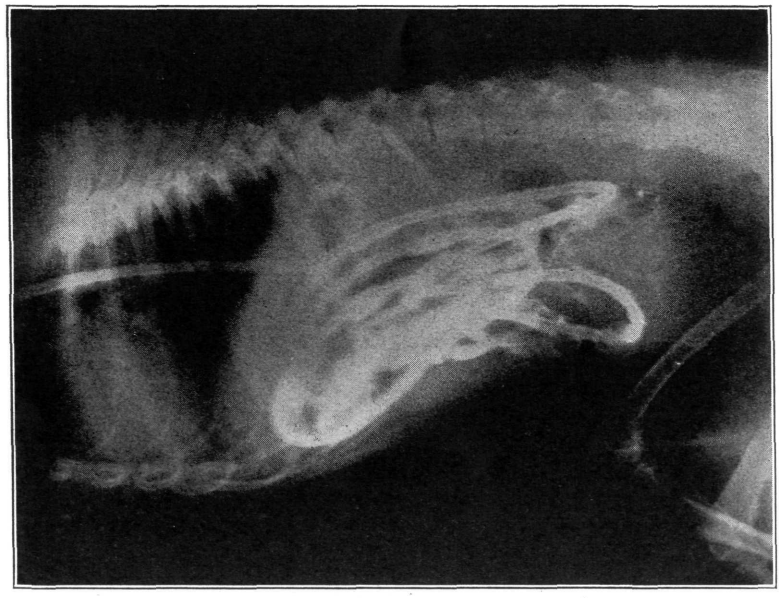

Fig. 2. Miller-Abbott tube at four-foot level (ileum) of dog.

permit aspiration or tandem balloon studies, for which the Miller-Abbott tube is used. Figure 2 shows the latter passed to the four foot level in a dog (with a small barium injection).

Refinements of technique (such as isolation of a section of gut by simultaneous inflation of a pair of balloons forming seals of proved efficiency) (3) now are appearing to make possible in the intact individual procedures formerly requiring surgery.

Following this trend toward more physiological, more chronic and more quantitative experimentation upon the digestive tract, we have developed a technique for intubation of the intact dog without training. One occasionally encounters an animal whose psychology precludes any co-operation, and which is so disturbed at being forced to remain quiet with an apparatus that the results are unsatisfactory for many purposes, and it may be that such animals constitute an irreducible minimum of unsuitable subjects. Usually, upon finding that struggle is useless and that relaxation brings comfort, the subject remains quiet.

The essence of the method is to place a bit made of transparent bakelite[2] in the dog's mouth, with the cross piece against the rear of the canine teeth. Here a natural space exists because of the rudimentary nature of the teeth immediately posterior to the canines. The bit is held against the roof of the mouth by a rubber strap over the upper jaw. (See Fig. 3.) The tube is threaded through this bit, which extends sufficiently to the rear to minimize coiling in the mouth and to prevent engagement of the tube by the molars.

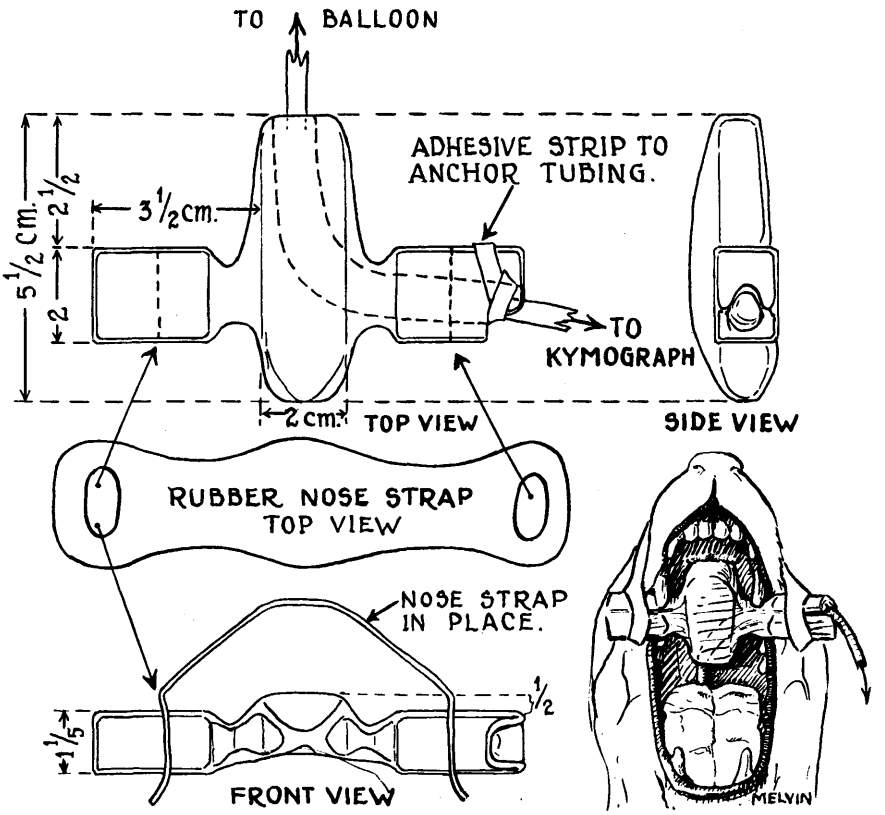

Fig. 3. Details of bit used as tube retainer.

When gastric intubation is sufficient, the tunnel for the tube is carried out through an end of the cross piece, which is cut away to provide a shoulder against which the tube may be taped to maintain it at the proper level. In intestinal work, where it is desirable to have the tube feed with the utmost freedom, (so that peristalsis will be sufficient to advance it at the proper rate) (2) the hole in the bit may be drilled straight through the body.

The bakelite is readily sawed and drilled with the common woodworking tools. It may be shaped with a half-round rasp and a round file. The curved tunnel for the tubing, after being drilled from each end, may be rounded out by threading a cord of hemp or twisted manila paper through the passage, fastening the free end to a clamp, and sawing the bit to and fro. The bit is filed to clear the canine and

[2]Obtainable from the Bakelite Corp., Park Avenue, New York City.

second premolar, and grooved or pitted slightly to place no weight on the first premolar. The teeth then act merely as guides to limit anterior and lateral displacement, the strap keeping the bit forward because of the slope of the nasal bones. The strap (cut from a discarded inner tube) is necked near each end to allow the edges to roll away from the nose. The whiskers may be trimmed.

A bit of the size given will fit any dog of the terrier type and weighing between twenty and thirty-five pounds. The jaws rest upon the bit without discomfort, and the animal can pant or vomit without hindrance from bit or tube. Surprisingly, gag reflex is rarely evoked by the tube. Mineral oil is suggested for lubricant because it is physiologically inert, though the tubing should be cleaned after use because of the possible deteriorating effect of oil on rubber.

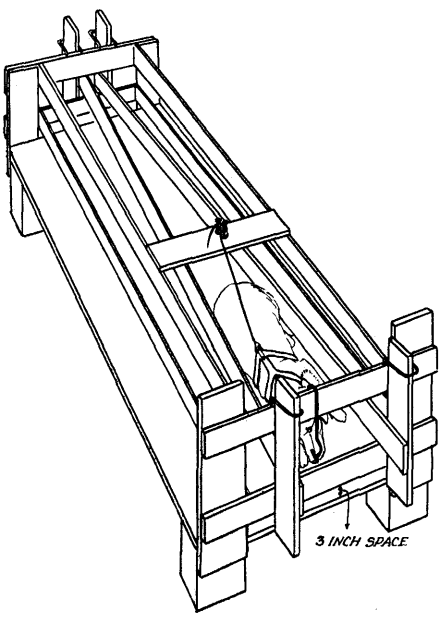

Fig. 4.
Adjustable restraining table.

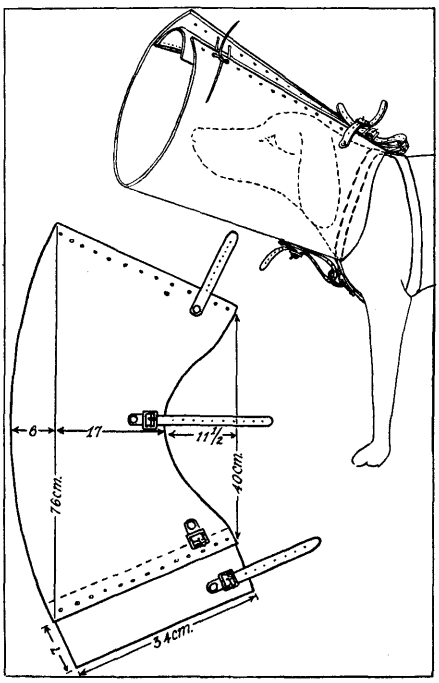

Fig. 5.
Modified Holmes funnel collar.

The dogs are kept in place by an adjustable stall and a standard shoulder harness, thus allowing them to lie upon either side or to stand, but not to leave the table nor to turn end for end and tangle the tube. (Fig. 4.) Dogs which insist upon pawing at the bit and tube are fitted with a modification of the Holmes funnel collar (4) which is strapped to the shoulder harness. An extra loop is riveted to the breastpiece of the harness for this purpose. (Fig. 5.) The shoulder harness should be of stout leather and well fitted, lest small loose-skinned animals learn to wriggle out of it, and to get their heads out of the funnel collar. Most animals, having tested to their satisfaction their inability to dislodge this apparatus, will lie quietly during protracted experiments, although occasional stroking by an attendant will reduce restlessness.

The region over the forearm is cleared with a depilatory, and intravenous injections may be given with a sharp 25 gauge needle into the radial vein. If an

attendant has plucked at the animal elsewhere to distract it, injections are unrecognized and hence made without evidence of psychic disturbance, as the animal lies hooded in the restraining frame. The side bars of the latter clear the table top by three inches, so that the legs of the animal may be drawn out as required. A metal table top is readily cleaned, affords the animals no traction, and they find it cool. It will be noted that the middle bar on each side of the frame may be moved in or out to accommodate varying sizes of animals and to vary the degree of restriction. The frame may be converted into a coop to further discourage movement by hinging a lattice to the bar upon which the leash is fastened, thus completely enclosing the animal.

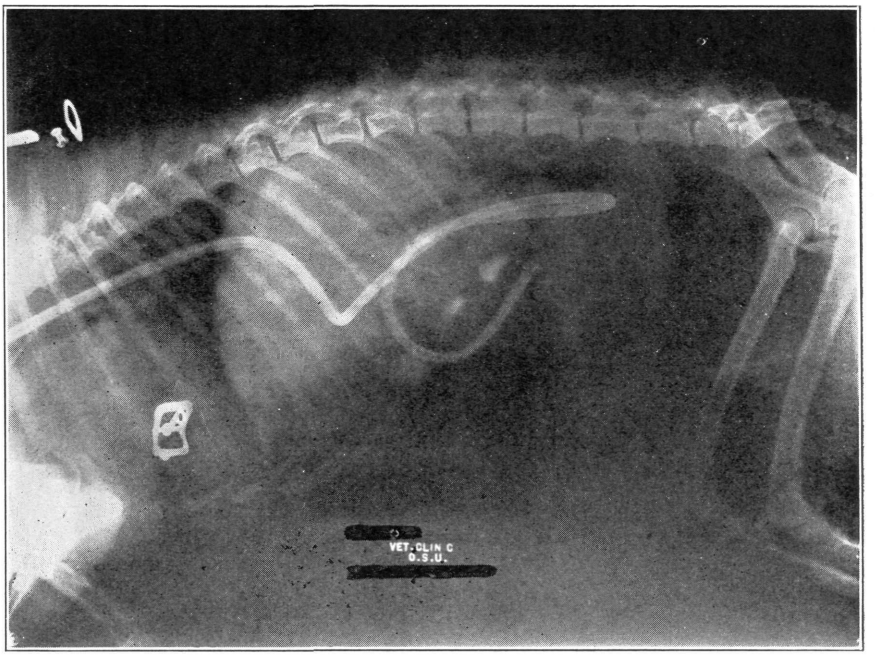

Fig. 6. Miller-Abbott tube being pulled through pylorus by pilot balloons.

The above methods have proved adequate for gastric intubation in all cases. Only in certain dogs will the Miller-Abbott tube readily pass the pyloric sphincter. For intestinal work one has the choice of testing until such an animal is found or performing a pyloroplasty. In the first case the tube should be fed very slowly, or taped to the bit at a level allowing several inches for duodenal penetration, and the balloon periodically inflated to see if it has dropped past the sphincter. If operation is used, the animal is no longer strictly intact, but if a Rammstedt, or even a modified Horsley operation is done, no fistula exists and there is negligible interference with the nerve and blood supply of the region and no undesirable fixation of the gut wall. In any case the level attained is identified by kymographic observation of the contractions upon the pilot balloon (duodenal motility is markedly different from that of the stomach) as well as by examining the fluids aspirated through the free lumen. (5)

Attempts have been made to devise a more positive method for passing the pyloric sphincter. A powerful magnet, acting on a ferrous bucket placed on the

tube, was tried and it was found at open operation that factors such as the spasticity of the sphincter and the presence of the rugae and of material in the stomach far outweighed the influence of the magnetic field at the distance through which the magnet must act. It was observed that coiling in the stomach was a prime obstacle, since it meant that the tip of the tube was in an unfavorable direction much of the time. (6) Since stiffer tubes seem to eliminate this, but are not sufficiently flexible for free passage to all levels, attempts were made to stiffen the tube until after passage of the sphincter by use of a wire stylet in the tube or of an external sleeve. Despite the aid of the fluoroscope, such methods have to date been disappointing. Most promising has been use of a tiny free pilot balloon on the end of six inches of string, which under the influence of duodenal peristalsis will bring the tip of the tube into position for passage of the pylorus during a moment of relaxation. If this pilot balloon contains barium, periodic fluoroscopic observation discloses the proper time for passing additional tubing to facilitate this, once the guide string has been engaged and can prevent the tube tip from recurving into the stomach and coiling. (Fig. 6) Further work is being done on this subject, which is of prime importance not only in facilitating research, but to the doctors throughout the country faced with urgent intubation of the seriously ill. Such methods as use of amyl nitrite to relax the sphincter (incidentally inhibiting peristalsis and causing circulatory disturbance) or of mercury to weight the pilot balloon, have obvious contra-indications or disadvantages.

SUMMARY

Methods are described for gastrointestinal intubation of intact, untrained and unanesthetized dogs, utilizing a bakelite bit which is strapped to the roof of the mouth, which has an extension carrying the tube clear of the molars and a cross piece fitted behind the canine teeth. The animals are placed in a stall allowing free motion up to the point of interference with the tube. A funnel collar is provided for unco-operative animals. Application of the Miller-Abbott principle of intestinal intubation to the dog is described, and the optimal method for passage of the pyloric sphincter is discussed.

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